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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/665,309	09/22/2003	Chen-Hua Yu	252011-1670	5444

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EXAMINER

LE, THAO X

ART UNIT PAPER NUMBER

2814

DATE MAILED: 09/12/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

10/665,309

Applicant(s)

YU ET AL.

Examiner

Thao X. Le

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 10 August 2006.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 19-25 and 27-42 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 19-25, 27-42 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date _____.
- 4) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____.
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____.

DETAILED ACTION

Continued Examination Under 37 CFR 1.114

1. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on 8/10/06 has been entered.

Claim Rejections - 35 USC § 102

2. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

3. Claims 19, 20, 23-24, 27, 28-30, 33, 42 are rejected under 35 U.S.C. 102(e) as being anticipated by US 6908847 to Saito et al.

Regarding claims 19 and 42, Saito discloses a metal structure in fig. 1 and 28, comprising: a semiconductor substrate 1, col. 8 line 41, with a conductor 9, col. 9 line 5,

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thereon; an insulating layer 20, col. 9 line 27, overlying semiconductor substrate 1 having a hole therein exposing the conductor 9, wherein the insulating layer 20 comprises silicon oxide (USG), a conductive plug P1, col. 9 line 40, substantially filling the hole and electrically connecting the underlying conductor 9; wherein the conductive plug P1 comprises tungsten P1b, col. 9 line 34, a carbon-doped silicon oxide or carbon and nitrogen-doped silicon oxide 501, col. 27 line 31, serving as an etch stop layer, on the insulating layer 20 and the conductive plug P1, fig. 28, a low dielectric constant layer 24b/26b, col. 27 line 35, overlying the carbon-doped silicon oxide or carbon and nitrogen-doped silicon oxide 501; a trench in the low dielectric constant layer 26b and the carbon-doped silicon oxide or carbon and nitrogen-doped silicon oxide 501, fig. 28, a diffusion layer PM2a, col. 14 line 23, lining the trench, fig. 28; and a copper or copper alloy conductor PM2b, col. 14 line 55, substantially filling the trench, electrically connecting the conductive plug P1, fig. 28.

With respect to silicon oxide or USG layer 20, silicon oxide or silicon dioxide is commonly known as USG (undoped silicate glass), see Awada (6949830) in col. 2 line 10 or Huang (6974766) in col. 2 line 55. Thus, Saito inherently discloses USG layer 20.

Regarding claims 20 and 23-24, 27, Saito discloses the structure wherein the conductive plug P1b comprises tungsten, col. 9 line 34, wherein the conductor 9 comprises metal, col. 8 line 60, wherein the insulating layer 20 comprises USG (silicon oxide), wherein the carbon content of the carbon-doped silicon oxide or carbon and nitrogen-doped silicon oxide 501 exceeds 21% (ratio of SiOC).

Regarding claims 28-30 Saito discloses the structure wherein the dielectric constant of the low dielectric layer 24b (SiOC) is less than 3.0. Typically, the dielectric constant of SiOC is about 2.7; see Ko (6913995) in col. 1 line 30, wherein the low dielectric layer 24b is formed by CVD, col. 27 line 34, wherein layer 24b is an inorganic material.

Regarding claim 33, Saito discloses the structure wherein the structure further comprises a Ta and/or TaN lining layer PM2a, col. 14 line 23.

Claim Rejections - 35 USC § 103

4. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

5. This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

6. Claim 21, 25, 31-32, 34-41 are rejected under 35 U.S.C. 103(a) as being unpatentable over US 6908847 to Saito et al. in view of US 6838363 to Wieczorek et al.

Regarding claim 21, Saito does not disclose the conductor 9 comprises metal silicide.

However, Wieczorek discloses a metal structure in fig. 2d wherein a conductor 208/212 comprises metal silicide 212, col. 9 line 12. At the time the invention was made; it would have been obvious to one of ordinary skill in the art to use the metal silicide teaching of Wieczorek with Saito's device, because such metal silicide would have good junction and low sheet resistance as taught by Wieczorek in col. 9 line 17.

Regarding claims 25, 31-32, 36, 39-40, Saito does not disclose the thickness of carbon-doped silicon oxide or carbon and nitrogen-doped silicon oxide 501 is less than 500 angstrom, wherein the hole is having a width of less than 950 angstrom, and wherein the trench is having a width of less than 1300 angstrom.

However, Saito discloses layer 501, the hole, and the trench having a general thickness and width. Accordingly, it would have been obvious to one of ordinary skill in art to use the teaching of Saito in the range as claimed, because it has been held that where the general conditions of the claims are disclosed in the prior art, it is not inventive to discover the optimum or workable range by routine experimentation. See *In re Aller*, 220 F.2d 454, 105 USPQ 233, 235 (CCPA 1955).

Regarding claim 34, Saito discloses a metal structure, comprising: a semiconductor substrate 1 with conductor 9 comprising tungsten 9c thereon, an insulating layer 20 overlying the semiconductor substrate 1 having a hole therein exposing the conductor 9, fig. 1, wherein the insulating layer 20 comprises USG (silicon oxide); a conductive plug P1 substantially filling the hole and electrically connecting the underlying conductor 9, wherein the conductive plug P1 comprises tungsten P1b; a carbon-doped silicon oxide or carbon and nitrogen-doped silicon oxide 501, serving as an etch stop layer, on the insulating layer 20 and the conductive plug P1, fig. 28; a low dielectric constant layer 24b/26b overlying the carbon-doped silicon oxide or carbon and nitrogen-doped silicon oxide 501; a trench in the low dielectric constant layer 24b and the carbon-doped silicon oxide or carbon and nitrogen-doped silicon oxide 501, a diffusion layer PM2a lining the trench; and a copper or copper alloy conductor PM2b substantially filling the trench, electrically connecting the conductive plug 58.

But, Saito does not disclose the conductor 9 comprising nickel silicide.

However, However, Wieczorek discloses a metal structure in fig. 2d wherein a conductor 208/212 comprises metal silicide 212, col. 9 line 12. At the time the invention was made; it would have been obvious to one of ordinary skill in the art to use the metal silicide teaching of Wieczorek with Saito's device, because such metal silicide would have good junction and low sheet resistance as taught by Wieczorek in col. 9 line 17.

Regarding claims 35, 37-38, 41 Saito discloses the structure wherein the conductive plug P1b comprises tungsten, col. 9 line 34, wherein the carbon content of

the carbon-doped silicon oxide or carbon and nitrogen-doped silicon oxide 501 exceeds 21% (ratio of SiOC), wherein the dielectric constant of the low dielectric layer 24b (SiOC) is less than 3.0. Typically, the dielectric constant of SiOC is about 2.7; see Ko (6913995) in col. 1 line 30, wherein the structure further comprises a Ta and/or TaN lining layer PM2a, col. 14 line 23.

7. Claim 22 are rejected under 35 U.S.C. 103(a) as being unpatentable over US 6908847 to Saito et al. in view of US 6806203 to Weidman et al.

Regarding claim 22, Saito does not disclose the semiconductor substrate 1 comprises silicon germanium.

However, Weidman discloses a metal structure wherein a substrate 100 comprises silicon, silicon germanium, or others suitable substrate, col. 7 lines 35-37. At the time of the invention was made; it would have been obvious to one of ordinary skill in the art to replace the substrate of Saito with the substrate teaching of Weidman, because such substrate replacement would have been considered a mere substitution of art-recognized equivalent values, MPEP 2144.06.

Response to Arguments

8. Applicant's arguments filed 8/10/06 have been fully considered but they are not persuasive.

a. The Applicant argues that Saito carbon-doped layer 501 is between two IMD layers of low-k materials; thus layer 501 is not ON the insulating layer and

the conductive plug. This is not persuasive because the final structure as claimed is in fig. 6 wherein etch stop layer 230 is ON but “not in contact” with the conductive plug 224. Apparently, the Applicant interpretation the word “ON” would be “in contact with “. The Examiner submits that the word “ON” has multiple meanings including “indicate position in close proximity with”. Thus, layer 501 of Saito would read on the claim language.

The Applicant argues that layer 501 of Saito would not act as an etch stop layer. This is not persuasive because the material in Saito is substantially identical to that of the claims, claimed properties or functions are presumed to be inherent. Or where the claimed and prior art products are identical or substantially identical in structure or composition, or are produced by identical or substantially identical processes, a *prima facie* case of either anticipation or obviousness has been established. *In re Best*, 195 USPQ 430, 433 (CCPA 1977) and MPEP 2112.01. Furthermore, it is well known that SiN, SiON, SiC, SiOC and other can act as an etch stop layer, see claim 7 of Daniels in IS 6583047.

Conclusion


9. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Thao X. Le whose telephone number is (571) 272-1708. The examiner can normally be reached on M-F from 8:00 AM - 4:30 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Wael M. Fahmy can be reached on (571) 272 -1705. The fax phone

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number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).



THAO X. LE
PRIMARY PATENT EXAMINER

06 Sept. 2006